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Much Ado About Nothing: The Zero Effect in Life-Saving Decisions

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Abstract

Zero is a special value in our daily lives, and previous research on how zero values affect decision making leaves many questions to be explored. The present research examined the zero effect in life-saving decisions and found that people expressed strong preferences for options offering a possibility that *no one will die,* even when the expected loss was relatively high. The prominence effect was proposed as one possible explanation, i.e., the notion that the option with possibly zero deaths is easy to defend and justify. Furthermore, we also found the zero effect in these life-saving decisions occurs only in loss framing rather than gain framing. We discuss the relationship between the zero effect, domain, framing, and evaluation mode.

Key words: zero effect; life-saving decisions

Introduction

Zero is a special number, which means null or nothing. In daily life, we often face commodities with zero value, e.g., a free product which costs no money or fat-free milk with no fat. Previous research has found that a zero value carries some special meaning (Gneezy & Rustichini, 2000; Hsee et al., 2013; Palmeira, 2011; Shampanier et al., 2007), and a variety of explanations for this effect have been suggested.

Shampanier et al. (2007) found that people react strongly to zero-price products and are much more willing to choose a free product rather than an inexpensive product that offers greater value. In one of their studies, participants chose between a Hershey's Kiss, a Ferrero Rocher chocolate, and buying nothing. In the 2&27 condition (Hershey's costs 2 cents and Ferrero costs 27 cents), percentages of participants choosing Hershey's and Ferrero were 45% and 40%. In the 1&26 condition (Hershey's costs 1 cent and Ferrero costs 26 cents), the percentages were both 40%. However, in the 0&25 condition (Hershey's costs nothing and Ferrero costs 25 cents), 90% of participants chose Hershey's, revealing a strong zero effect. Additional studies led the authors to conclude that affect plays a crucial role in the zero effect; i.e., a free product not only costs nothing, but also carries some special affective benefit.

However, the zero-comparison effect proposed by Palmeira (2011) argues that in some situations a zero attribute removes a reference point that people use to evaluate the size of attribute differences, and the comparison to zero is meaningless because any number is infinitely larger than zero. Therefore, people do not know exactly how good or bad the zero value is, and would not react strongly to the option with zero compared to a low near-zero value. In one of his studies, participants were asked to choose a hi-fi system, where sound quality is an important attribute. In the control condition people chose between two options with the values of sound quality represented as 0.003% and 0.01% respectively; in the zero-value condition, the two values were 0.00% and 0.01%. Eighty-three percent of the participants choose the 0.003% option in the control condition, and yet only 56% choose the zero-value option. Palmeira argues that people did not appreciate the zero-value option because zero lacked a reference point to compare it to in order to evaluate its meaning.

These studies suggest different mechanisms underlying reactions to zero in different contexts. In the present study, we aimed to examine and explain the zero effect in decisions where lives were at stake. In these decisions, zero value refers to zero loss (i.e., *no one will die*) and the zero option is the one with a chance that *no one will die*. An example is an option in which *there is a 50% chance seven people will die and a 50% chance no one will die*. Taking into account the findings by Shampanier et al. (2007) and Palmeira (2011), we hypothesized a strong zero effect existing in life-saving decisions. First, life is so precious that the zero option may carry the special affective meaning observed by Shampanier et al. (2007) and thus would be preferred, perhaps even when it was otherwise disadvantageous. Second, as zero loss of life is obviously the best outcome in a life-saving scenario, a reference point proposed by Palmeira (2011) is not necessary to highlight its attractiveness.

Regarding this last point, according to the prominence effect (Slovic, 1975; Tversky et al., 1988), people prefer options that are easy to justify and defend. When lives are at risk, choosing an option offering a chance that no one will die should be quite easy to justify. We tested this hypothesis in Study 1.

Furthermore, in life-saving decisions, the zero effect means the option with *no one will die* is much more attractive. Logically, *all will be saved* in gain framing carries the same meaning as *no one will die* in loss framing. Previous studies have found that gain and loss framings may induce different decisions (Kahneman & Tversky, 1979; Tversky & Kahneman, 1981). Accordingly, in Study 2, we aimed examined the zero effect in logically equivalent gain and loss framings; e.g., all will be saved vs. no one will die.

There are two opposing predictions regarding the zero effect in gain framings for life-saving scenarios. On one hand, Tversky and Kahneman (1986) found that people prefer options with certain outcomes to alternatives with uncertain outcomes. In gain framing, compared to a percentage (e.g., *98% of lives will be saved*), which is uncertain, *all will be saved* is much more certain and should be preferred. On the other hand, Slovic et al. (2002) found that saving 98% of 150 lives received higher support ratings than did saving 150 lives. A high percentage is easy to evaluate as very good because it is very close to the upper bound 100%, whereas saving 150 lives is diffusely good and hard to evaluate (Hsee, 1996). Therefore, there may be no zero effect in gain framing. Which of these predictions is correct is examined in Study 2.

Study 1

Method

Participants were 302 adults (118 female; *M* age = 32 years) recruited on Amazon Mechanical Turk (MTurk) and living in the United States. They were asked to consider the following scenario:

Imagine the following. Ten people are injured in one accident. You are nearby and have two rescue options to decide between. Both options have some risk. Which one will you choose?

Option A: 50% chance four people will die and 50% chance three will die. [This option remained the same for all conditions.]

Option B: 50% chance five people will die and 50% chance two will die. [This option varied by condition.]

Participants were randomly assigned to one of the following six conditions with different choices for option B. For conditions 1 through 3, option A offered the same expected loss of life as option B, and these conditions were designed to test the occurrence of the zero effect. For conditions 4 through 6, option B offered a greater expected loss of life than option A as well as a possible zero loss, and these conditions were designed to examine the strength of the effect.

Condition 1 (*N* = 51)

Option B1: 50% chance five people will die and 50% chance two will die.

Condition 2 (*N* = 50)

Option B2: 50% chance six people will die and 50% chance one will die.

Condition 3 (*N* = 48)

Option B3: 50% chance seven people will die and 50% chance no one will die.

Condition 4 (*N* = 52)

Option B4: 50% chance eight people will die and 50% chance no one will die.

Condition 5 (*N* = 50)

Option B5: 50% chance nine people will die and 50% chance no one will die.

Condition 6 ($N = 51$)

Option B6: 50% chance ten people will die and 50% chance no one will die.

Participants chose between the two options, rated their strength of preference for their chosen option, and gave a brief explanation for their choice. Strength of preference was measured on a five-point Likert Scale, ranging from *no preference* to *very strongly prefer*.

Results

Tests of the zero effect. The percentage of participants choosing option B for each condition is shown in Figure 1. A significant effect of condition was found for the percentage of choices ($\chi^2(5, N = 302) = 15.86$, $p = 0.007$).

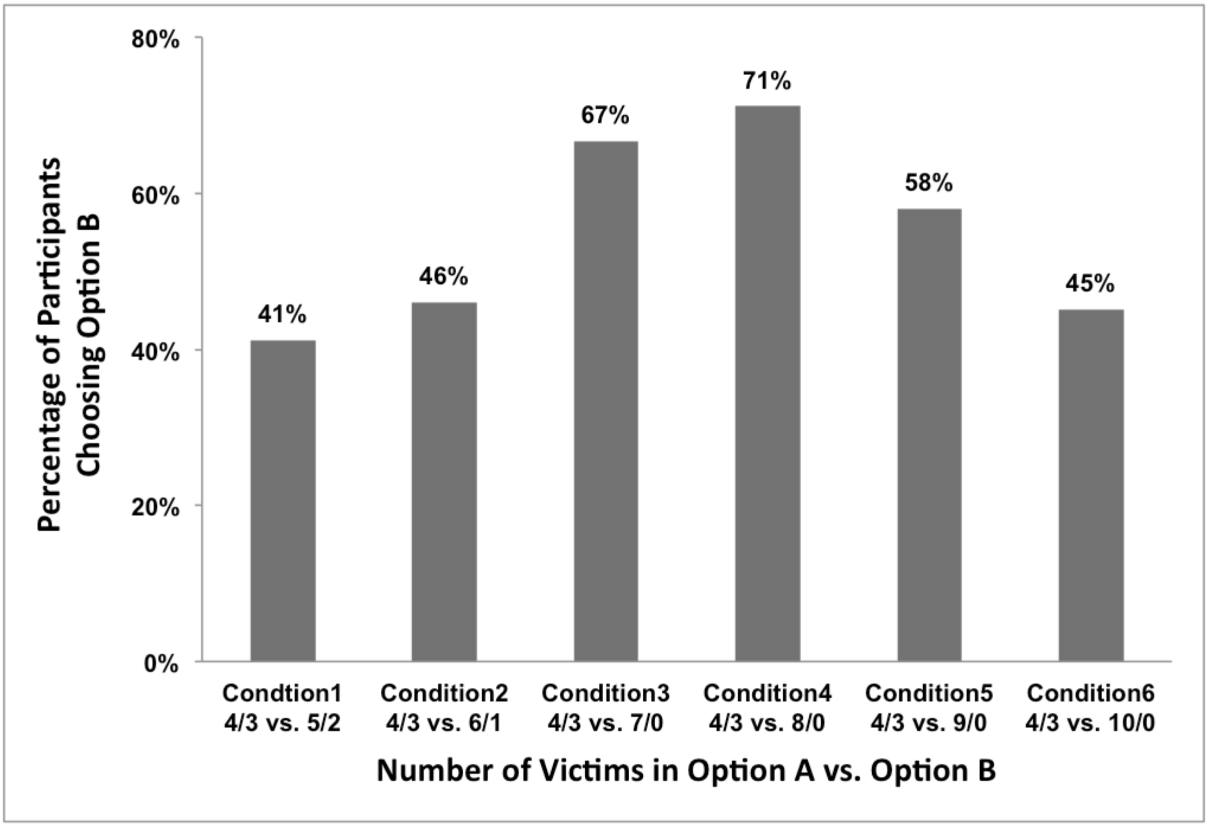

Figure 1. Percentage of participants choosing option B for each condition.

Results in conditions 1 through 3 revealed a strong zero effect. For conditions 1 through 3, option B offered the same expected loss of life as option A, and yet when the minimum loss of life decreased to zero in condition 3, a much greater proportion of people chose option B. Specifically, for conditions 1 and 2, when the minimum number of victims was two or one, the percentages of people choosing option B (i.e., 41% and 46%) were less than 50%, and there was no significant difference between the two percentages ($\chi^2(1, N = 101) = 0.24, p = 0.625$). However, in condition 3 when there was a chance that no one would die, the percentage increased to 67%, which was significantly higher than those in condition 1 ($\chi^2(1, N = 99) = 6.46, p = 0.011$) and condition 2 ($\chi^2(1, N = 98) = 4.25, p = 0.039$).

Strength of the zero effect. Results in conditions 4 through 6 examined the strength of zero effect. For conditions 4 through 6, option B offered a larger expected loss of life than option A, and the minimum loss of life was always zero. In condition 4, the percentage of people choosing option B was not significantly different from that in condition 3 ($\chi^2(1, N = 100) = 0.24, p = 0.628$), and yet was significantly higher than that in condition 2 ($\chi^2(1, N = 102) = 6.66, p = 0.010$). As the expected loss of life increased in condition 5 and condition 6, the zero effect attenuated and the percentage decreased to 45%, which was close to 46% in condition 2.

Strength of preference. Strength of preference for option A as well as option B was recoded into a single continuous scale (option A: *no preference* = 0, *slightly prefer* = –1, *prefer* = –2, *strongly prefer* = –3, *very strongly prefer* = –4; option B: *no preference* = 0, *slightly prefer* = 1, *prefer* = 2, *strongly prefer* = 3, *very strongly prefer* = 4). Means on this scale are shown in Figure 2 for each condition. A higher value indicated that people preferred option B more and option A less.

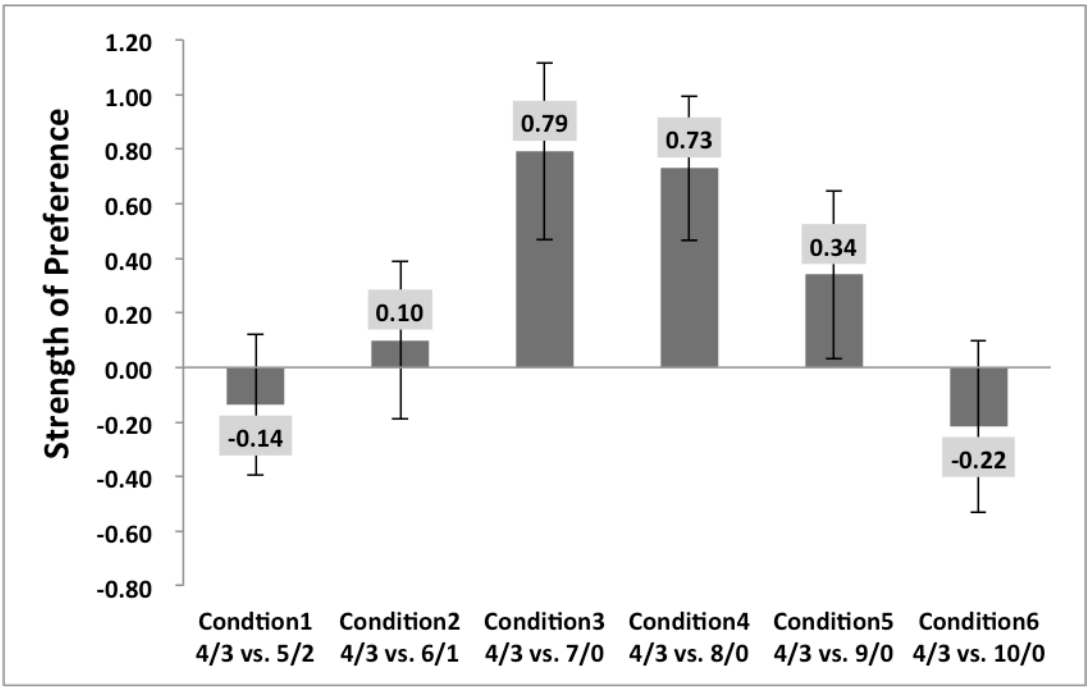

Figure 2. Strength of preference for each condition. Error bar indicates standard error.

The data in Figure 2 exhibited the same pattern of support for the zero effect as was shown in Figure 1. The main effect of condition was marginally significant ($F(5, 302) = 2.13$, $p = 0.062$, $\eta^2 = 0.035$). Further analysis showed that preference for option B in condition 3 and condition 4 was significantly higher than that in condition 1 (condition 3 vs. 1: $p = 0.027$; condition 4 vs. 1: $p = 0.035$), and there was no difference between condition 3 and condition 4 ($p = 0.884$) or between condition 1 and condition 2 ($p = 0.568$). As the expected loss of life increased in condition 5 and condition 6, the zero effect attenuated, and in condition 6 the strength of preference was significantly lower than that in condition 3 and condition 4 (condition 6 vs. 3: $p = 0.017$; condition 6 vs. 4: $p = 0.022$).

A negative quadratic trend in preference across conditions was also found ($F(1,302) = 4.79$, $p = 0.009$), reflecting the large increase in preference for option B when that option included the outcome *no one will die*, but flattening and decreasing as the expected loss of lives increased.

Explaining the zero effect. Participants also indicated which of two reasons would be more defensible or justifiable if they had to defend their choice against criticism, one of which was *I did not want anyone to die* (abbreviated reason 1) and the other was *I wanted to minimize the maximum number of people who may die* (abbreviated reason 2). Reason 1 would lead to the zero-value option, while reason 2 would lead to the alternative. To analyze the relationship between zero effect and the underlying reason, we chose to examine condition 3 in which the two options have the same expected value.

For condition 3, option A was *50% chance four people will die and 50% chance three will die*; option B was *50% chance seven people will die and 50% chance no one will die.* It is reasonable to predict that if people agree more with reason 1, they would choose option B, while if they agree more with reason 2, option A would be preferred.

The results, presented in Table 1, supported this prediction. There were 48 participants in condition 3. Thirty-two participants chose option B, of which twenty-eight (i.e., 87.5%) selected reason 1. Sixteen participants chose option A, of which fifteen (i.e., 93.8%) selected reason 2. These results indicate that participants chose the zero-value option (i.e., option B) mainly based on reason 1 (i.e., *I did not want anyone to die*).

Table 1. Options and Reasons Chosen in Condition 3

	Reason 1	**Reason 2**
Option A	1	15
Option B	28	4

Overall, in this study, we found a strong zero effect in life-saving decisions. A possible explanation related to the prominence effect was also provided to account for the zero effect; that is, the zero-value option is much preferred because, as the best single outcome, it is easy to justify and defend. In the next study, we tested the robustness of the zero effect and examined the relationship between the zero effect and framing.

Study 2

In the scenarios of Study 1, a strong zero effect was found within loss framing (e.g.., *no one will die*). Logically, *zero* in loss framing (e.g., *no one will die*) has the same meaning as *all* in gain framing (e.g., *all will be saved*). In Study 2 we aimed to examine the zero effect in both gain and loss framings in a rating task.

Method

Participants were 724 adults (304 female; *M* age = 33.5 years) recruited with Amazon Mechanical Turk (MTurk) and living in the United States. They were asked to consider the following airport safety scenario adapted from Slovic et al. (2002):

> Imagine you are a member of the emergency response committee of your local Airport. There is a proposal before your committee to purchase some expensive new equipment for use in the event of a crash landing of an airliner. The circumstances that might require such equipment to be used are rare but important.
>
> In the case of a crash landing, the new equipment would be expected to save 98% of the 150 lives (the percentage and framing varied by condition) that would be at risk in such an event.

Critics argue that the money spent on this equipment could be better spent enhancing other aspects of airport safety.

How strongly would you support this proposed measure to purchase the new equipment?

Participants were randomly assigned to one of the following nine conditions. Conditions 1 through 5 employed gain framing, while conditions 6 through 9 used loss framing. Conditions 1, 2, 3 and conditions 6, 7 carry the same meaning logically: so do conditions 4 and 8, and conditions 5 and 9.

Condition 1 ($N = 77$): save all of the 150 lives

Condition 2 ($N = 80$): save 100% of the 150 lives

Condition 3 ($N = 82$): save the 150 lives

Condition 4 ($N = 81$): save 98% of the 150 lives

Condition 5 ($N = 81$): save 90% of the 150 lives

Condition 6 ($N = 82$): lose none of the 150 lives

Condition 7 ($N = 80$): lose 0% of the 150 lives

Condition 8 ($N = 81$): lose 2% of the 150 lives

Condition 9 ($N = 80$): lose 10% of the 150 lives

Participants rated their support for purchasing the life-saving equipment on a 20-point Likert Scale, ranging from *would not support at all* (0) to *moderate support* (10) to *very strong support* (20).

Results

Mean rated support for purchasing life-saving equipment in the nine conditions is presented in Figure 3.

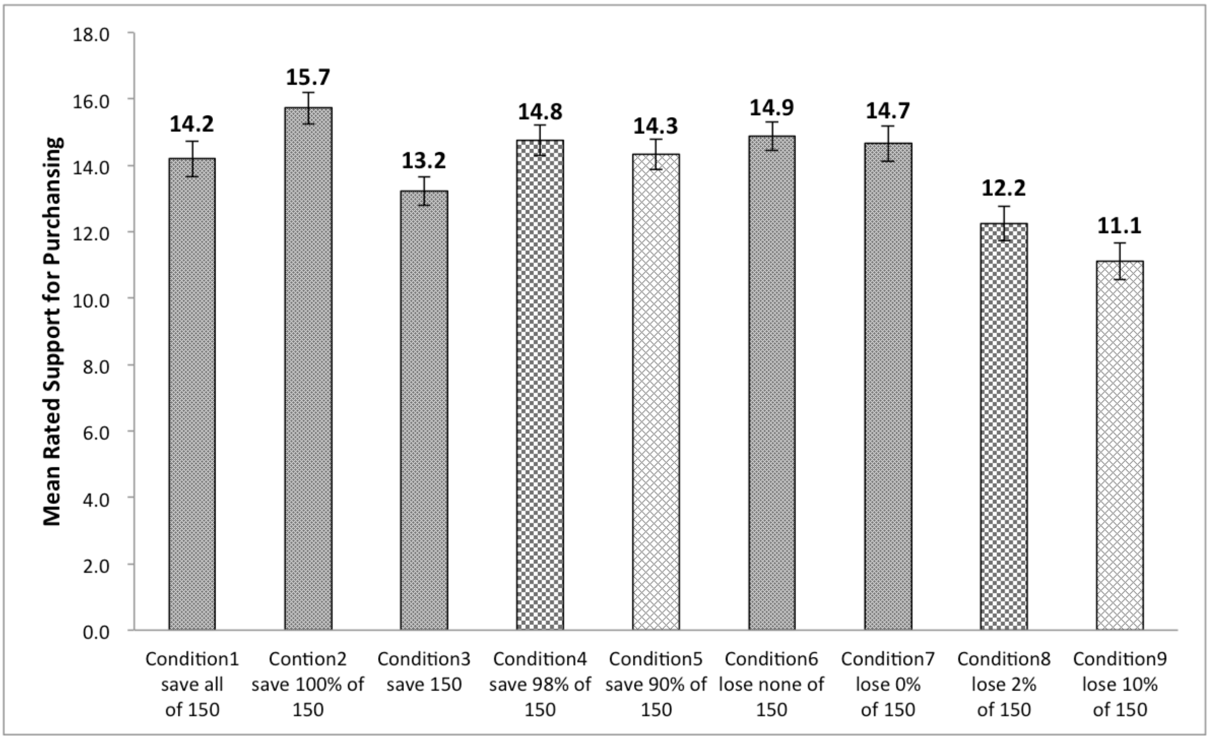

Figure 3. Mean rated support for purchasing life-saving equipment in each condition. Error bar indicates standard error.

No zero effect in gain framing. Conditions 3 and 4 were taken from the original airport safety study by Slovic et al. (2002). Support was much higher for saving 98% of 150 lives than for saving 150 lives ($t(161) = 2.44$, $p = 0.016$, $d = 0.399$), replicating the earlier finding and failing to show a certainty effect. Moreover, condition 3 obtained the lowest support of all five gain-frame conditions, lower even than condition 5 with 90% saved ($t(161) = 1.78$, $p = 0.077$, $d = 0.275$), again replicating Slovic et al. (2002). Where the number of lives saved was explicitly highlighted by the word *all* or by a percentage saved in conditions

1, 2, 4, and 5, there were no statistically significant differences,[1] and thus no greater support for conditions that saved *all* or 100% vs. 98% or 90%. There was thus no clear advantage to 100% certainty.

A strong zero effect in loss framing. In contrast to gain framing, there was a strong zero effect with loss framing. Conditions 8 and 9, with 2% and 10% losses of life, were rated far less worthy of support than conditions 6 and 7 (lose none; lose 0%): (conditions 6 vs. 8: $t(161) = 3.92$, $p < 0.001$, $d = 0.629$; conditions 6 vs. 9: $t(160) = 5.34$, $p < 0.001$, $d = 0.846$; conditions 7 vs. 8: $t(159) = 3.26$, $p = 0.001$, $d = 0.532$; conditions 7 vs. 9: $t(158) = 4.59$, $p < 0.001$, $d = 0.737$). Mean rated support in condition 8 (lose 2%) was not significantly higher than that in condition 9 (lose 10%): ($t(159) = 1.50$, $p = 0.135$, $d = 0.230$).

Gain vs. loss framing. Conditions 1 and 2 (save all, save 100%) were not significantly different from their equivalent loss versions (lose none and lose 0%) in conditions 6 and 7 (conditions 1 vs. 6: $t(157) = 0.99$, $p = 0.322$, $d = 0.161$; conditions 2 vs. 7: $t(158) = 1.47$, $p = 0.143$, $d = 0.219$) . However, once losses of life became greater than zero, large differences emerged. Condition 4 (98% saved) received far greater support than condition 8 (lose 2%); $t(160) = 3.65$, $p < 0.001$, $d = 0.595$; and condition 5 (save 90%) received far greater support than condition 9 (lose 10%); $t(159) = 4.49$, $p < 0.001$, $d = 0.703$.

Discussion of Study 2. The greater support for saving 98% of 150 lives compared to saving 150 lives replicated the finding in Slovic et al. (2002) that was explained in terms of the concept of evaluability (Hsee, 1996) and the affect heuristic (Slovic et al., 2007). In the separate evaluation mode of Study 2, the number 150 appears diffusely good, without a

[1] Mean rated support in condition 4 (save 98%) was not significantly higher than that in condition 5 (save 90%); ($t(160) = 0.65$, $p = 0.516$, $d = 0.122$).. Furthermore, there was no difference between the ratings in conditions 1 and 4 ($t(156) = 0.80$, $p = 0.428$, $d = 0.136$), nor between conditions 2 and 4 ($t(159) = 1.46$, $p = 0.146$, $d = 0.213$).

reference point to clarify its precise value. But saving 98% appears close to 100% saved, which in condition 2 received high support. So 100% likely serves as a reference point against which saving 98% (147 out of 150) seems good, and consistent with predictions from the psychophysical nature of prospect theory's value function (Kahneman & Tversky, 1979). Even saving 90% may seem quite good (saving 135 lives of 150).

Although Study 2 did not find a zero effect in the life saving frame, there was a strong zero effect in the loss frame. Condition 8, described as losing 2%, received far lower support ratings than conditions 6 and 7 (lose none and lose 0%), and condition 9, with its 10% loss of life, fared even worse. With losses of life, zero provides a strong reference point, much as 100% does for lifesaving, and, according to the value function of prospect theory, changes close to zero would have relatively greater impact. The greater defensibility of actions resulting in no loss of life would also predict the results we found.

General Discussion

The present studies demonstrated a strong zero effect in certain life-saving decisions. A number of psychological factors seem to underlie the variability of this effect. Attempting to escape a dangerous situation with no loss of life is easy to defend and justify, consistent with the prominence effect or imperative based decision rules (e.g. we must not allow anyone to die; Mazarr, 2016). Finding that the zero effect occurs in loss framing but not in gain framing points to the importance of implicit reference points, everyone saved for gains and no one dying for losses. Small deviations from these reference points, within the framework of prospect theory's nonlinear value function, would also explain the emergence of the zero effect with loss frames but not with lifesaving frames.

The Zero Effect and Reference Points in Other Domains

The zero effect is consistent with the finding by Shampanier et al. (2007) that people strongly prefer zero-price products over inexpensive products. According to Shampanier et al. (2007), products may become particularly attractive by virtue of being "free."

Consistent with the importance of reference points in the present studies, Palmeira (2011) found that a zero option would not be favored without a reference point that would allow it to be compared to a small value.

Thus the zero effect clearly differs across decision domains. In some situations, the affective quality of a zero value is obvious, while in others, the lack of reference point makes zero hard to evaluate. In the study by Shampanier et al. (2007), free chocolate was obviously a good quality, while in the study by Palmeira (2011), the zero value describing the sound quality of an audio system was hard to appreciate. The interaction between zero and reference points in other decision contexts seems worthy of further study.

Other Frames

We examined life-saving scenarios framed around zero-losses (e.g., *no one will die*) and complete gains (e.g., *all will be saved*). Future research could also test the zero effect based on zero-gain (i.e., *no one will be saved*) in gain framing and all-loss (i.e., *all will die*) in loss framing. Based on the great importance of protecting an individual life (Västfjäll et al., 2014) we would expect that options in which one life might be saved would be strongly preferred over options in which there was a possibility that no one would survive. Whether avoidance of scenarios that include an "all will die" possibility is wise or not would depend on the specifics of the probabilities and outcomes in the options.

The Importance of Context

The present findings demonstrate the often strong impacts of subtle contextual factors such as wording and mode of response (e.g. single vs. joint evaluation) on the evaluation of risky options. In this way, they supplement previous studies that have found the meaning and importance even of familiar outcomes to depend greatly on contextual factors that influence the evaluability of those outcomes and the resulting affect (Bateman et al., 2007). For example, the attractiveness of playing a simple gamble (7/36 to win $9; otherwise win nothing) is greatly enhanced by introducing a small loss (7/36 win $9; otherwise lose 5¢). This occurs because in the first instance win $9 is hard to evaluate as good or bad and thus does not influence the judgment. Adding the 5 cents loss makes the $9 gain seem quite attractive, raising the gamble's appeal. In addition, the No-Loss gamble (7/36 win $9; 29/36 you lose nothing) is rated much more attractive than the No-Win gamble (7/36 win $9; 29/36 you win nothing), since the tone of *lose nothing* is much more positive than that of *win nothing*.

Conclusion

For a number representing nothing, zero has a surprising importance in our lives. Without context, zero is of little interest or concern. But, as an outcome of a decision, it can be a matter of life or death.

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